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(54) Photoelectric densitometer

(57) In the reproduction of originals, assessment of the original is generally effected by eye and evaluation is by experience. The invention seeks to effect measurement of the graduation characteristics automatically and provides therefore a method of analysing an original image, wherein the original is illuminated by light of constant brightness by way of an aperture which corresponds to the desired format of a subsequent reproduction of the image, at least one colour filter being selected from a plurality of colour filters and inserted in the path of the light modified by the original image, and a photoelectric measuring unit being provided to measure the total intensity of the light emanating from the portion of the original defined by the aperture.

In apparatus for carrying out this method, there is provided a holder 6 arranged in a housing 1 to receive the original image, a light source 8, 11 or 12 of pre-determined, constant brightness arranged within the housing to illuminate the image, means 61-64 to alter the aperture through which the light impinges on the image, photoelectric means 5 (preferably a photomultiplier) to measure the full range of intensity of the light coming from the original through the area bounded by the aperture, and an arrangement 52 for introducing colour filters in turn into the light path in front of the opto-electrical measuring unit. As shown, the apparatus may also include a logarithmic amplifier 55 and a digital indicator 13.

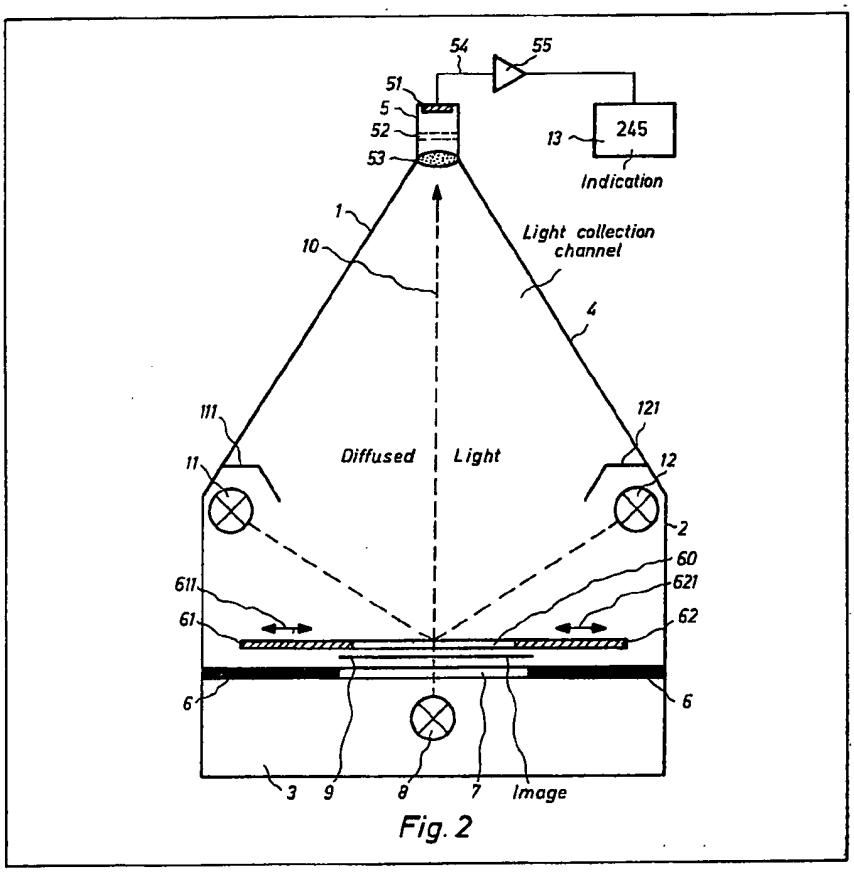

Fig. 2

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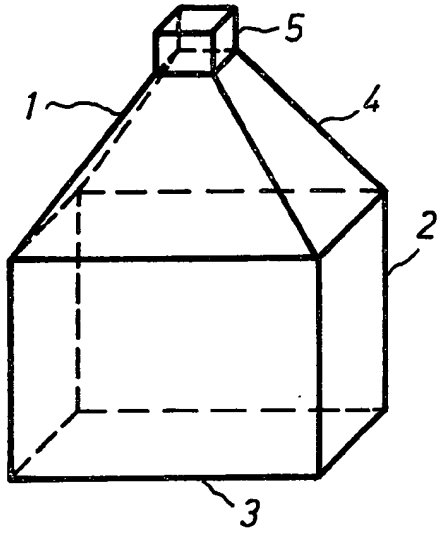

Fig. 1

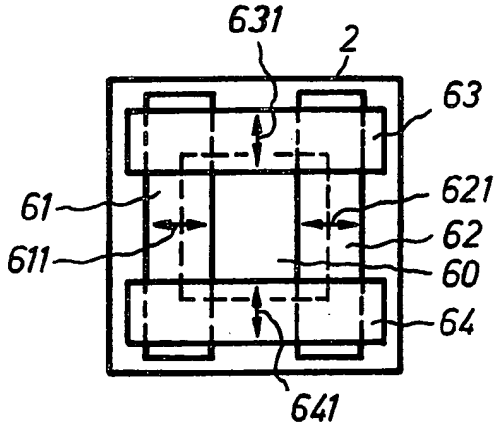

Fig. 3

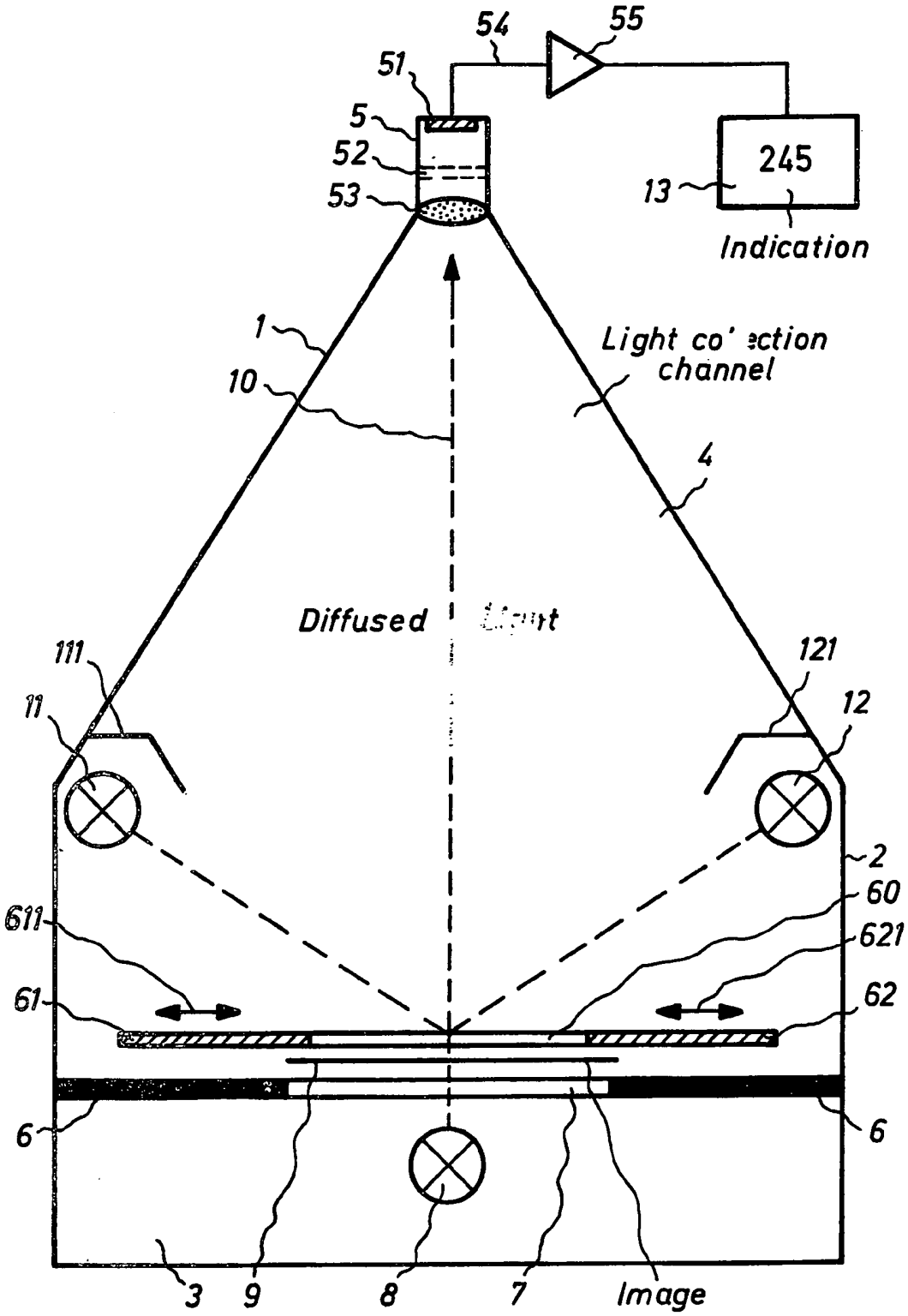
54
55
51
5
52
53
245
13
Indication
1
10
Light co' ection channel
4
Diffused
111
121
11
12
2
611
60
621
61
62
6
6
3
9
8
7
Image

Fig.2

SPECIFICATION

Method and apparatus for measuring the gradation characteristics of an original for reproduction

The present invention relates to a method of an apparatus for measuring the gradation characteristics of an original image.

When producing reproductions of images by a printing process, and particularly in the case of offset or gravure printing, difficulties arise in achieving a constant quality of reproduction at all times. This is caused by the fact that the images which are intended for reproduction, particularly when they are transparencies or opaque pictures, differ widely from one another in the range of their tonal values. These differences may be caused by differing film sensitivities or by differences in the development of the films or finally by the actual exposure of the film.

To avoid these disadvantages, the procedure with methods known hitherto has been a visual and subjective one of examining the image before reproduction. This is done by an operator who looks at the image and decides the parameters which are to be introduced into the printing process.

These parameters are in particular the gradation setting on the apparatus used for reproduction. The purpose of this measure is to ensure that both the highlights and the medium tones and the dark tones of the original are reproduced as well as possible. The disadvantage of this purely subjective procedure is that the same quality of reproduction is not always achieved and that the assessment which is made differs from operator to operator, given that this is an empirical method which relies on evaluation by comparison with values gained from experience. Exact and objective reproduction of the colour values which are present in the image is therefore not possible with the conventional visual method. This is particularly important because, with electronic reproduction processes, it is not possible to use the known technique of masking, such as is customary in photomechanical reproduction.

Another known method of measurement is to make spot measurements of an original to find its density characteristic. This is done with transmission or reflection densitometers but likewise has the disadvantages that it depends on the experience of the operator which spots in the picture he considers characteristic and measures, and that the evaluation of the measured values and their conversion into the corresponding printing parameters are subject to the subjective judgement of the individual operator.

It is therefore an object of the invention to avoid or minimise this known visual and subjective method and to provide a new method which employs an optical measurement of gradation.

The invention consists firstly in a method of analysing an original image, wherein the original is illuminated by light of constant brightness by way of an aperture which corresponds to the desired format of a subsequent reproduction of the image, at least one colour filter being selected from a plurality of colour filters and inserted in the path of the light modified by the original image, and a photoelectric measuring unit being provided to measure the total intensity of the light emanating from the portion of the original defined by the aperture.

The invention also consists in apparatus suitable for carrying out the method as set forth in the preceding paragraph.

In order that the invention may be more clearly understood reference will now be made to the accompanying drawings which schematically show important features thereof by way of example and in which:–

Figure 1 is a schematic view of a housing for apparatus for carrying out one embodiment of the method of the invention,

Figure 2 is a schematic axial section through the apparatus of Figure 1, and

Figure 3 shows an example of a diaphragm for adapting to an extracted portion of the image to be reproduced.

Referring now to the drawings, the apparatus which is shown in Figure 1 comprises a hook-like housing 1 which consists of a lower part 2, which has a rectangular base 3, and of an upper part 4 set on top of the lower part 2. The upper part 4 is in the shape of a pyramid and includes a measuring unit 5 which is fitted thereto.

Figure 2 shows a horizontally arranged holder 6, which is mounted in the housing 1, situated approximately half way up the lower part 2. The holder contains a first central aperture 7 through which the light rays from a light-source 8, which is arranged underneath the first aperture 7, pass and in so doing shine through a transparency 9; two further light sources 11, 12 may be provided above the first aperture 7 for use in illuminating opaque pictures. Above the holder 6 are provided means to determine the shape of a selected portion of the image which is subsequently to be reproduced. These means may be formed by four movable plates which cover the unreproduced part of the image and allow the light to pass only through a selected area, the light thus passing through the actual selected and extracted part of the image. Adjustable diaphragms of this kind having a square-cornered aperture are known in X-ray engineering for determining the film format or the format of the beam cross-section.

Figure 3 is a schematic view of such a diaphragm, comprising movable plates 61, 62, 63 and 64 which are movable in the direction of arrows 611, 621, 631 and 641 and which form a second aperture 60.

In Figure 2 only plates 61 and 62 and arrows 611 and 621 are shown for simplicity.

The light source 8 is so arranged that its light rays pass through the entire picture when the diaphragm is fully open. The light passing through the aperture is represented diagrammatically by a broken line 10 and is collected in the apparatus by the pyramidal upper part 4 and is measured in the measuring unit 5.

When an opaque image, i.e. an image having reflective characteristics, is used rather than the transparency 9, it is the light reflected from this image which is measured. For this purpose fluorescent lamps, which give a diffuse light, are preferably provided, these lamps being represented in the sec-

tional view of Fig. 2 only, by light sources 11 and 12. These light sources are preferably provided with cowls 111 and 121 to prevent direct radiation from the light source into the measuring unit 5. To ensure uniform illumination of the original it is advantageous to provide not only the light sources marked 11 and 12 but also one such light source along each widthwise side of the housing. Fluorescent lamps of this nature are particularly suitable since they give a diffuse light and the reflected light within the measuring unit allows complete measurement of all the light reflected or transmitted by the original.

The measuring unit 5, which is in the form of a turret on the upper part of the housing, contains a photoelectric semi-conductor 51, preferably a photocell of large surface area or a photo-multiplier which can also be used as an amplifier for the light. The photocell used my be a photocell of the UDT, PIN/10 type made by Messrs United Detector Techn, Santa Monica, California.

Immediately below the photocell is an arrangement 52 to receive colour filters, which are inserted in dependance upon the colour which is to be measured. Normally, three colour filters are used, namely red, green and blue filters, which can be inserted in the arrangement one after the other. Such filters are commercially available and can be obtained in the form of so-called "Wratten filters" made by Messrs Kodak. The filter changing mechanism is also known and in commercially available densitometers takes the form of a turret head. An example which may be mentioned is the densitometer made by Messrs. Kollmorgen AG of Zug, Switzerland.

Underneath the filter arrangement 52 a lens 53 is mounted, and this lens 5 focusses the light collected by the pyramidal upper part of the housing and directs it onto the photocell 51. The current or signals which are emitted by the photo cell 51 are fed via a line 54 and an amplifier 55 to an electronic indicator device 13 which preferably gives a digital indication.

If necessary the amplifier 55 may be in the form of a logarithmic amplifier. When this is the case the instrument indicates density values directly because the signals are in logarithmic form. An indicator instrument of this kind, e.g. a commercially available digital volt-meter, makes reading and light measurement with the individual colour filters easier and thus prevents errors in reading.

It should be mentioned that before the image is measured a comparative measurement is made to calibrate the arrangement. At the time of this measurement the second aperture 60 is adjusted to the extracted portion of the image which is to appear in the subsequent reproduction. From this preliminary measurement and the results of the subsequent measurement can be found the full amount of light which passes through the corresponding portion of the original.

The signals which are obtained by inserting the various filters in the light path may simply be added, and the sum of the measured value signals which is obtained in this way can be compared with an empirically established standard value. In this way the other technical activities, i.e. the individual gradation setting required, at the apparatus for producing the colour separations are made independent of individual judgement. By this simple arrangement it becomes possible to determine gradation objectively and making the measurement on a predetermined section of the image produces an accurate measured value for the full tone scale within the image.

Apparatus in which such arrangements are used contain gradation stages in which the gradation characteristic e.g. in light, dark and medium tones, can be altered. Such gradation stages are for example shown in Fig. 6 of US patent specification no. 2,968,709. In US patent no. 3,885,244, a stage of this kind is merely shown schematically in Fig. 4 as units 101 to 104.

Due to its small size and simplicity the present apparatus is completely mobile and can therefore be used to evaluate originals to be reproduced when advising clients.

The photo-electric measuring means may be used in conjunction with scanning means to evaluate the selected image area.

CLAIMS

1. A method of analysing an original image, wherein the original is illuminated by light of constant brightness by way of an aperture which corresponds to the desired format of a subsequent reproduction of the image, at least one colour filter being selected from a plurality of colour filters and inserted in the path of the light modified by the original image, and a photoelectric measuring unit being provided to measure the total intensity of the light emanating from the portion of the original defined by the aperture.

2. A method according to claim 1, wherein red, green and blue filters are used.

3. A method according to claim 1 or 2, wherein the original is transparent and the light measured is that which passes through the original and is defined by the apertures.

4. A method according to claim 1, 2 or 3, wherein the value measured by the opto-electrical measuring unit is indicated on an indicating means.

5. A method according to claim 1, wherein a plurality of colour filters is provided and the light intensity is measured individually with each of the colour filters, these measured values being added and compared with an assigned standard value, any deviation from this standard value being used to adjust the gradation setting of reproduction apparatus.

6. Apparatus for carrying out the method according to claim 1 comprising a holder arranged in a housing to receive the original image, a light source of predetermined, constant brightness arranged within the housing to illuminate the image, means to alter the aperture through which the light impinges on the image, photoelectric means to measure the full range of intensity of the light coming from the original through the area bounded by the aperture, and an arrangement for introducing colour filters in turn into the light path in front of the opto-electrical measuring unit.

7. Apparatus as claimed in claim 6, including red, green and blue filters for interposition in the light path.

8. Apparatus as claimed in claim 6 or 7, wherein the lower part of the housing is of rectangular cross-section and the upper part is in the form of a truncated pyramid which has a turret to hold the measuring unit.

9. Apparatus as claimed in claim 8, wherein the turret to hold the measuring head supports a lens, an arrangement for exchanging the colour filters, and a photocell of large surface area.

10. Apparatus as claimed in any of claims 6 to 9, wherein a logarithmic amplifier is provided between the indicator instrument and the measuring unit.

11. Apparatus as claimed in any of claims 6 to 11, wherein the photo-electric measuring unit is a photo-multiplier.

12. Apparatus as claimed in any of claims 6 to 11, wherein an adjustable diaphragm is provided having a cross-section substantially of rectangular shape to define the selected and extracted portion of the image.

13. Apparatus as claimed in any of the preceding claims 6 to 12, wherein the photo-electric measuring unit includes means for scanning the selected image area for evaluation thereof.

14. A method of analysing an original image substantially as hereinbefore described with reference to the accompanying drawings.

15. Apparatus for analysing an original image substantially as hereinbefore described with reference to the accompanying drawings.

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